

REMARKS

This is a Supplemental Response to the Office Action mailed October 5, 2009, and in furtherance of Applicants' Response filed on January 5, 2010. Fifty-seven (57) claims, including eight (8) independent claims, were paid for in the application. Claims 50, 53, 55, 57, 60, 68, 70-71 and 73-79 are canceled by way of this Response, and claims 10, 11, 16, 31, 32, 34-37, 40, 41, 43-48, 56, 66, 67, 69 and 72 were previously canceled. Claims 1-6, 9, 12-15, 17, 18, 27, 28, 30, 38, 52, 58 and 61-63 have been amended. Claims 80-86 have been added. No new matter has been added to the application. Claims 1-9, 12-15, 17-30, 33, 38, 39, 42, 49, 51, 52, 54, 58-59, 61-65 and 80-86 are pending. The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

Examiner Interview

Applicants thank Examiner Beck for conducting a telephonic interview with Applicants' representative, Mr. Eric M. Ringer, on January 22, 2010.

During the interview, proposed amendments to independent claims 1, 9, 12, 38 and 62 were discussed and contrasted to the cited references. In particular, Applicants' representative proposed amending claim 1 to recite limitations similar, but not identical, to aspects of objected to claim 4. In addition, Applicants' representative proposed amending claim 62 to recite limitations similar, but not identical, to aspects of objected to claim 55. The Examiner indicated that the proposed amendments to claim 1 and claim 60 included the allowable subject matter from claim 4 and claim 55, respectively.

Applicants' representative and Examiner Beck discussed the Sato, Guy and Matsumoto references in relation to brakes that prevent a spool from rotating. The Examiner agreed that modifying the teachings of Sato in view of Guy to include a spool on which cable is wound and unwound and then further modifying Sato, as modified by Guy, to include a brake as taught by Matsumoto would not be obvious and would alter the principles of operation of Sato.

Independent claims 9 and 12 have been amended in accordance with the aforementioned discussion.

Applicants' representative indicated that Applicants intended to amend claims reciting various mathematically based limitations, such as reciting specific equations and optimizing equations, by deleting such limitations. Independent claims 1, 9, 12, 38 and 62 have been amended accordingly, and claims 68, 70, 71 and 73-79 have been canceled.

Further, Applicants' representative and Examiner Beck discussed a calibration point at which reference lengths of four cables are known. Examiner Beck indicated that, in his opinion, Sato disclosed such. In particular, Examiner Beck indicated that Figure 4 and equation 1 of Sato disclosed a calibration point at which cable lengths were known. No agreement was reached on claim language to distinguish over the cited references. However, Applicants' representative believes that the interview helped clarify issues related to the calibration and thanks the Examiner for explaining his interpretation of Sato.

#### Allowed Claims

Applicants thank Examiner Beck for allowing claims 18-25, 29, 30 and 33.

Claim 18 has been amended to clarify that lengths of cable are coupled to a first end of a tool shaft and that the lengths of cable are wound and unwound on a spool. Applicants believe that the amendments to claim 18 do not affect allowability of claim 18.

Dependent claim 30 has been amended to clarify that a tool is moved to vertices of a tetrahedron at which a cable guide is positioned. Applicants respectfully submit that claim 30 is allowable for at least the reason that claim 30 depends from allowed claim 29.

#### Objected to Claims

Dependent claims 4 and 55 stand objected to for depending indirectly and directly from rejected independent claims 1 and 62, respectively.

Claims 1 and 62 have been amended in accordance with proposed amendments discussed in the aforementioned interview.

Claims Rejected Under 35 U.S.C. §103(a)

Claims 1-3, 5-9, 12-15, 17, 26-28, 38, 39, 42, 49, 51, 52, 54 and 61-65 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Sato et al. (U.S. Patent 5,305,429, hereafter “Sato”) in view of one or more references. In particular, claims 3, 38, 49, 51 and 61-65 stand rejected as being unpatentable over Sato in view of Guy et al. (U.S. Patent 6,879,315, hereafter “Guy”); claims 12, 13, 17, 39, 42, 52, 54, and 59 stand rejected as being unpatentable over Sato in view of Guy and Stork et al. (U.S. Patent 6,104,380, hereafter “Stork”); claims 1-3 and 58 stand rejected as being unpatentable over Sato in view of Guy and Massie et al. (U.S. Patent 5,587,937, hereafter “Massie”); and claims 5-8 14, 15, and 26-28 stand rejected as being unpatentable over Sato in view of Guy, Massie, and Stork.

Amended Claim 1

As described above, claim 1 has been amended to generally include limitations of “objected to” claim 4. In particular, claim 1 recites, in part, “establishing means for establishing a respective distance between each of the first, the second, the third, and the fourth cable guides and the attachment point, the establishing means including a memory configured to receive and store, prior to a complete shutdown of the device, the respective distances between each of the first, the second, the third, and the fourth tool translation effector devices and the attachment point, and to provide the stored distances during a startup procedure.” (Emphasis added.)

As discussed in the aforementioned interview, the amendment to claim 1 does not include all of the limitations of claim 4, nor limitations from intervening claims 57 and 58. However, Applicants respectfully submit that claim 1 has been amended in accordance with subject matter discussed in the aforementioned interview and includes the subject matter the Examiner indicated as being allowable. Therefore, Applicants respectfully submit that claim 1 is in condition for allowance.

Further, in accordance with the aforementioned interview, independent claim 1, as amended, no longer recites, among other things, “calculating means for calculating a force response vector ... the calculating means is configured to calculate the force response vector according to the equation  $J = (A\tau - f) + \alpha[\tau]^2 \dots$ ”.

Previously presented claims 2-8 and 58 and newly added claim 80 depend, directly or indirectly, from claim 1 and, consequently, are allowable for at least the reason that they depend from an allowable claim.

Amended Claims 9 and 12

Claims 9 and 12 have been amended to incorporate limitations that clarify distinctions between claimed subject matter and the cited references. In particular, claims 9 and 12 have been amended to recite aspects similar to aspects of previously presented dependent claims 2 and 50. (Previously presented claim 2 depended from claim 1 and recited, among other things, translator effector devices having respective spools. Previously presented claim 50 depended from independent claim 9 and recited limitations directed to brakes for claimed translator effector devices that locked the tool translation effector devices while the haptic interface device is powered down.) The Office Action cited Sato and Guy in the rejection of claim 9 and cited Matsumoto for allegedly disclosing the limitations related to “brakes,” as recited in previously presented claim 50. Guy was cited for allegedly disclosing translator effector devices having respective spools. (See, Office Action, pages 15 and 16, rejection of claim 2.) Therefore, Sato, Guy and Matsumoto are discussed below in relation to amended claim 9.

Claim 9, as amended, recites, in part, “a plurality of tool translation effector devices, each having a spool with an end of a respective one of the plurality of cables coupled thereto such that, as the attachment point moves relative to that tool translation effector device, the cable coupled thereto is retracted or paid out accordingly ... and a first, a second, a third, and a fourth brake, each respective brake coupled to a respective tool translation effector device of the first, the second, the third, and the fourth tool translation effector devices and configured to prevent rotation of the respective spool of the respective tool translation effector device having the respective brake coupled thereto while the haptic interface device is powered down.” (Emphasis added.)

In the aforementioned interview of January 22, 2010, Applicants’ representative and the Examiner discussed amendments to claims 9 and 12, and the Examiner indicated such

amendments to claim 9, and similar amendments to claim 12, would overcome the respective rejections. Applicants respectfully submit that the amendments to claims 9 and 12 are in accordance with subject matter discussed in the aforementioned interview.

In particular, amended claims 9 and 12 recite tool translation effector devices that have a respective spool and brakes in which each brake is coupled to a respective tool translation effector device, and each brake is configured to prevent rotation of the spool associated with the respective tool translation effector device while the haptic interface device is powered down.

Thus, Applicants respectfully submit that claims 9 and 12, as amended, include the subject matter discussed in the interview of January 22, 2010, and that, as indicated by the Examiner in the aforementioned interview of January 22, 2010, claims 9 and 12 are non-obvious in light of the cited references.

Previously presented claims 49, 51, 52 and 59 and newly added claim 81 depend from claim 9 and, consequently, are allowable for at least the reason that they depend from an allowable claim.

Similarly, previously presented claims 13-15, 26-28, 42 and 54 and newly added claim 82 depend, directly or indirectly, from claim 12, and consequently, are allowable for at least the reason that they depend from an allowable claim.

#### Amended Claim 38

Claim 38 has been amended to recite aspects of claim 60 that are not taught or suggested by the cited references.

Amended claim 38 recites, in part, “during a calibration of a cable based haptic interface device, positioning a tool having four segments of cable coupled thereto at a specified single calibration point from which respective reference lengths of each of the four segments of cable is known, each segment of cable coupled to the tool and having a respective length extending from the tool to a respective vertex of a tetrahedron ... [and] establishing the respective length of each of the four segments of cable based at least on the tool being positioned at the calibration point and on the respective reference lengths of each of the four segments of cable.” (Emphasis added.)

Sato does not disclose calibration of his instruction point, let alone, positioning a tool at a single calibration point at which reference lengths of four cables are known during calibration of a cable-based haptic interface device. As described above, Examiner Beck indicated that, in his opinion, Sato disclosed a calibration point at which reference lengths of four cables are known. In particular, the Examiner indicated that such was disclosed by Sato at column 4, lines 2-5 and 37-63, and Figure 4. In particular, the Examiner indicated that point  $P(X,Y,Z)$ , as shown in Figure 4, is a calibration point. The point  $P(X,Y,Z)$ , as shown in Figure 4, is not a single calibration point. Rather, Figure 4 and column 4, line 27 through column 5, line 58, describe the mathematics used to determine a position of the instruction point based on lengths of cables from respective fulcrums (14-1 to 14-4) to the instruction point. There is no discussion in Sato of calibration in general, let alone, calibration at a single calibration point at which distances of the four cables are known.

Sato does not teach or suggest positioning a tool at a single calibration point at which reference lengths of four cables are known during calibration of a cable-based haptic interface device. In the interview of January 22, 2010, the Examiner indicated that because equal weights are attached to the lines 14-1 to 14-4 (column 4, lines 2-5), the instruction point 10 will be pulled back to the point  $P(X,Y,Z)$ , as shown in Figure 4, when the instruction point is released. Assuming merely for the sake of argument that the point  $P(X,Y,Z)$ , as shown in Figure 4, is located at the geometric center of the cubic structure having fulcrums (14-1 to 14-4) at vertexes, then, at the center, the net force on the instruction point 10, via tension in lines 12-1 to 12-4, is zero. In theory, if the instruction point 10 is displaced from the geometric center of the cube by a "small" amount, then there will be a "small" net force on the instruction point due to the "small" displacement.

However, as discussed in the aforementioned interview, the instruction point is not pulled back to the geometric center of the cube when the instruction point is released from an arbitrary location. When the instruction point is released at an arbitrary location, there will be a net tension force (*i.e.*, the vector sum of tension in the lines) acting to pull the instruction point toward the geometric center, and in addition, there will be frictional forces, kinetic or static friction, in the pulleys (38) that will oppose rotation of the pulleys. As the instruction point

approaches the geometric center, the magnitude of the net tension force will decrease but the magnitude of the (kinetic) friction forces in the pulleys will be approximately constant. At some point, the (kinetic) friction forces in the pulleys will equal the net tension force and movement of the instruction point will stop, even though the instruction point is not at the geometric center. Thus, one cannot calibrate Sato by merely releasing the instruction point from a location that is not the geometric center because the instruction point will not be pulled back to the geometric center.

Further, as discussed in the aforementioned interview, Guy does not teach or suggest positioning a tool at a calibration point at which distances are known. Rather, Guy discloses that the system has the capability to initialize position and that the system can be moved (manually or under the control of software) through ranges of motion to geometrically calibrate the workspace. (See, column 13, lines 47-54.) Guy would not move the system through “ranges of motion” to geometrically calibrate the workspace if Guy had a single calibration point at which distances were known.

For at least the reasons above, Sato and Guy fail, individually and collectively, to disclose, teach or suggest at least “during a calibration, positioning a tool ... at a specified single calibration point from which respective reference lengths of each of the four cables is known,” as recited in amended claim 38. Therefore, Applicants respectfully request that the rejection of claim 38 be withdrawn.

Previously presented claims 39 and 61 and newly added claim 83 depend from claim 38, and consequently, are allowable for at least the reason that they depend from an allowable claim.

#### Amended Claim 62

As described above, claim 62 has been amended to incorporate limitations of “objected to” claim 55. In particular, claim 1 recites, in part, “locking, during a shutdown procedure, the first cable at the spool; storing a value indicative of a known length of the first cable in a memory; and recovering the value indicative of the known length of the first from the memory during a startup procedure.”

As discussed in the aforementioned interview, the amendment to claim 62 does not recite the exact limitations of claim 55 due to antecedent basis problems in claim 55. In particular, claim 55 recited a “plurality of cables,” and claim 62 recited “a first cable.” However, as discussed in the aforementioned interview, the amendments to claim 62 include the subject matter that the Examiner indicated as being allowable. Therefore, Applicants respectfully submit that claim 62 is in condition for allowance.

Claims 63-65 depend from claim 62, and consequently, are allowable for at least the reason that they depend from an allowable claim.

#### Additional Cited References

Applicants respectfully submit that the pending claims are allowable over the aforementioned cited references and over Stork and Massie.

Massie is cited for haptic system that calculates a force response on the basis of a position of an attachment point. However, Massie fails to disclose, teach or suggest, at least a brake that prevents a spool from rotating and fails to disclose, teach or suggest, at least during a calibration, positioning a tool at a specified single calibration point from which respective reference lengths of each of the four cables is known.

Stork is cited for a sensor array. However, Stork fails to disclose, teach or suggest, at least a brake that prevents a spool from rotating and fails to disclose, teach or suggest, at least during a calibration, positioning a tool at a specified single calibration point from which respective reference lengths of each of the four cables are known.

Consequently, for at least the reasons discussed above, Applicants respectfully submit that the pending claims are allowable over the cited references.

#### New Claims

Claims 80-86 are added.

Claims 80-82, which depend from claims 1, 9 and 12, respectively, include claim language in which respective brakes lock respective encoders in position. Support for claims 80-82 may be found at least at page 22, line 26 through page 23, line 3.

Claim 83, which depends from claim 38, includes recites, inter alia, “manually positioning the tool at the specified single calibration point.” Support for claim 83 be found at least at page 26, lines 18-25.

Claims 84-86 are added, and generally correspond to claims 29, 30 and 33, respectively.

### Conclusion

Applicants respectfully submit that the pending claims are in condition for allowance. Any remarks in support of patentability of one claim should not be imputed to any other claim, even if similar terminology is used. Any remarks referring to only a portion of a claim should not be understood to base patentability on that portion; rather, patentability must rest on each claim taken as a whole. A number of clarifying amendments have also been made to the above claim set. Applicants do not acquiesce to each of the Examiner’s rejections and to each of the Examiner’s assertions regarding what the cited references show or teach, even if not expressly discussed herein. Although changes to the claims have been made, no acquiescence or estoppel is or should be implied thereby; such amendments are made only to expedite prosecution of the present application and are without prejudice to the presentation or assertion, in the future, of claims relating to the same or similar subject matter.

If the undersigned attorney has overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found. In light of the above amendments and remarks, Applicants respectfully submit that all pending claims are allowable. Applicants, therefore, respectfully request that the Examiner reconsider this application and timely allow all pending claims. The Examiner is encouraged to contact the undersigned by telephone to discuss the above and any other distinctions between the

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claims and the applied references, if desired. If the Examiner notes any informalities in the claims, the Examiner is encouraged to contact the undersigned by telephone to expediently correct such informalities.

Respectfully submitted,  
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